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4 Sheets-Sheet 1

The diagram illustrates a complex fluid management system. A main chamber (10) contains a fan (11) and a pump (12) connected by a series of tubes (13). A filter (15) is also present. A secondary chamber (30) is connected to the main chamber via a network of pipes (43, 44, 45, 46) and valves (41, 42). The system is powered by an external unit (40) connected to a power source (39). Arrows indicate the direction of fluid flow throughout the circuit.

34

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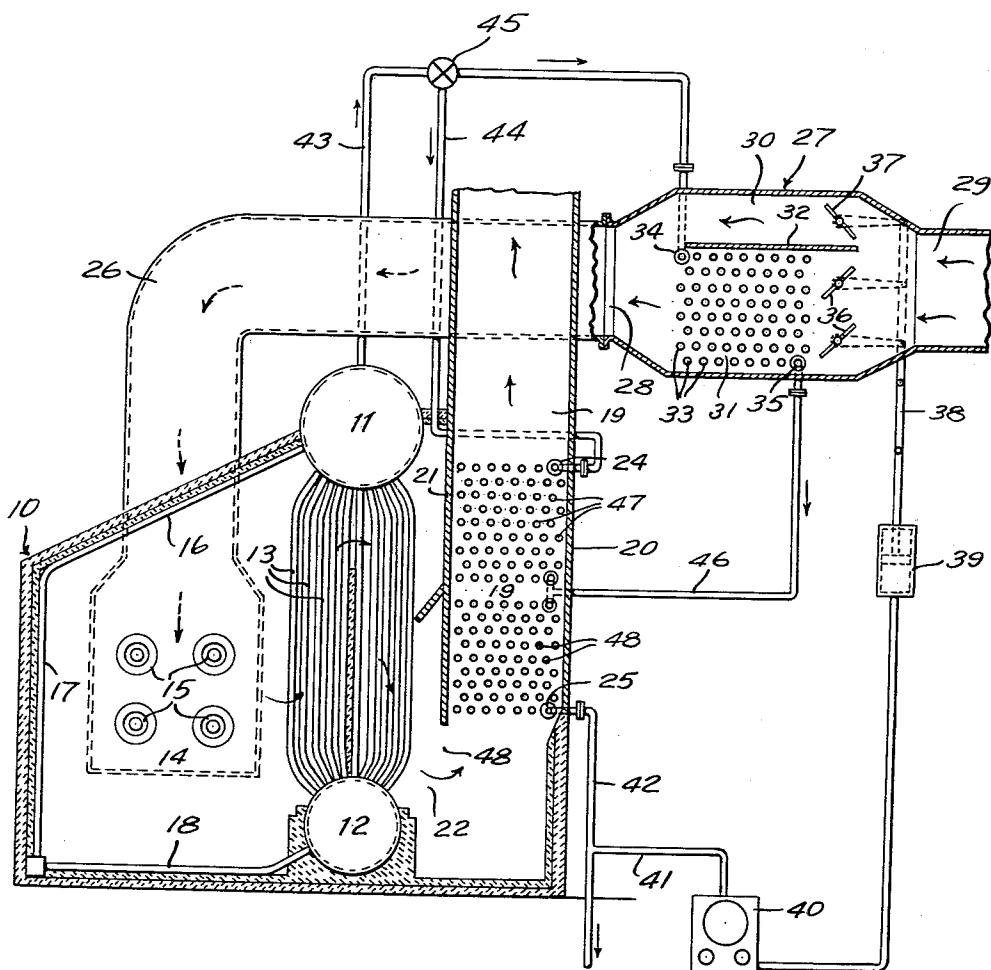
2,713,330

VAPOR GENERATING AND SUPERHEATING APPARATUS

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4 Sheets-Sheet 2

Fig. 2.



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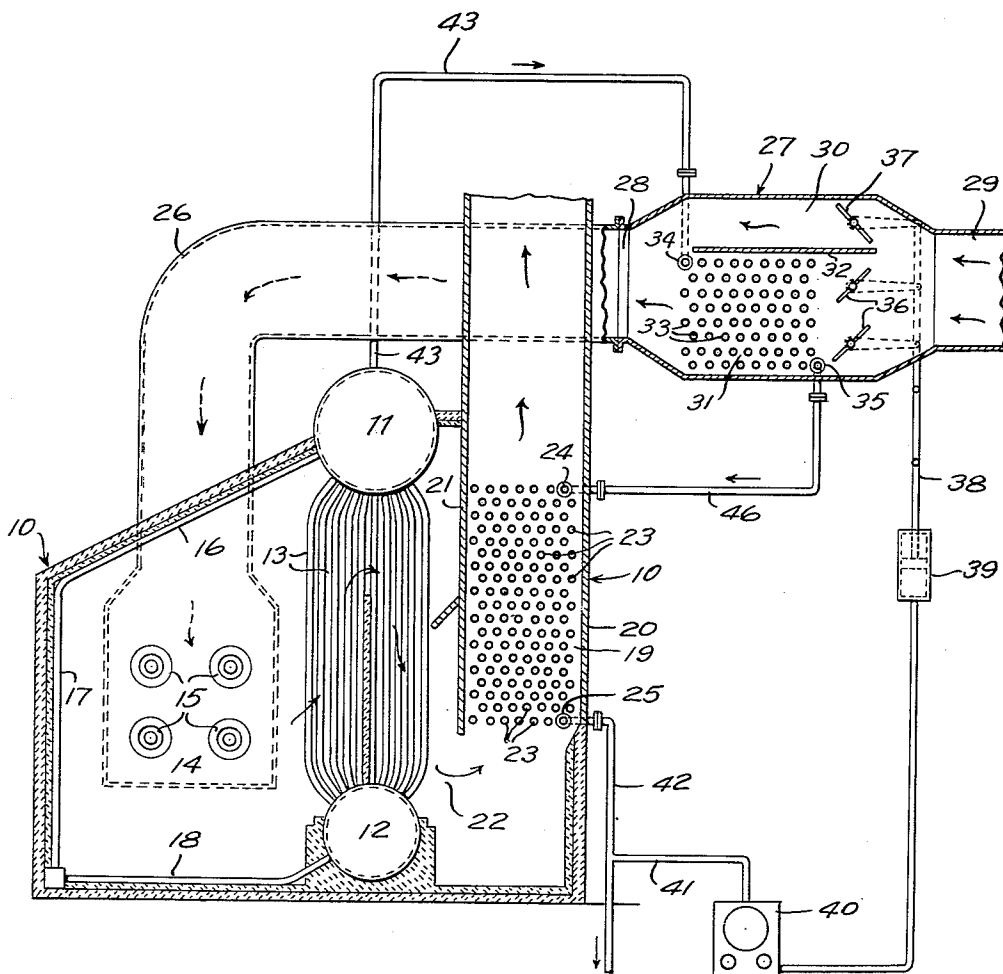
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4 Sheets-Sheet 3

Fig. 3.



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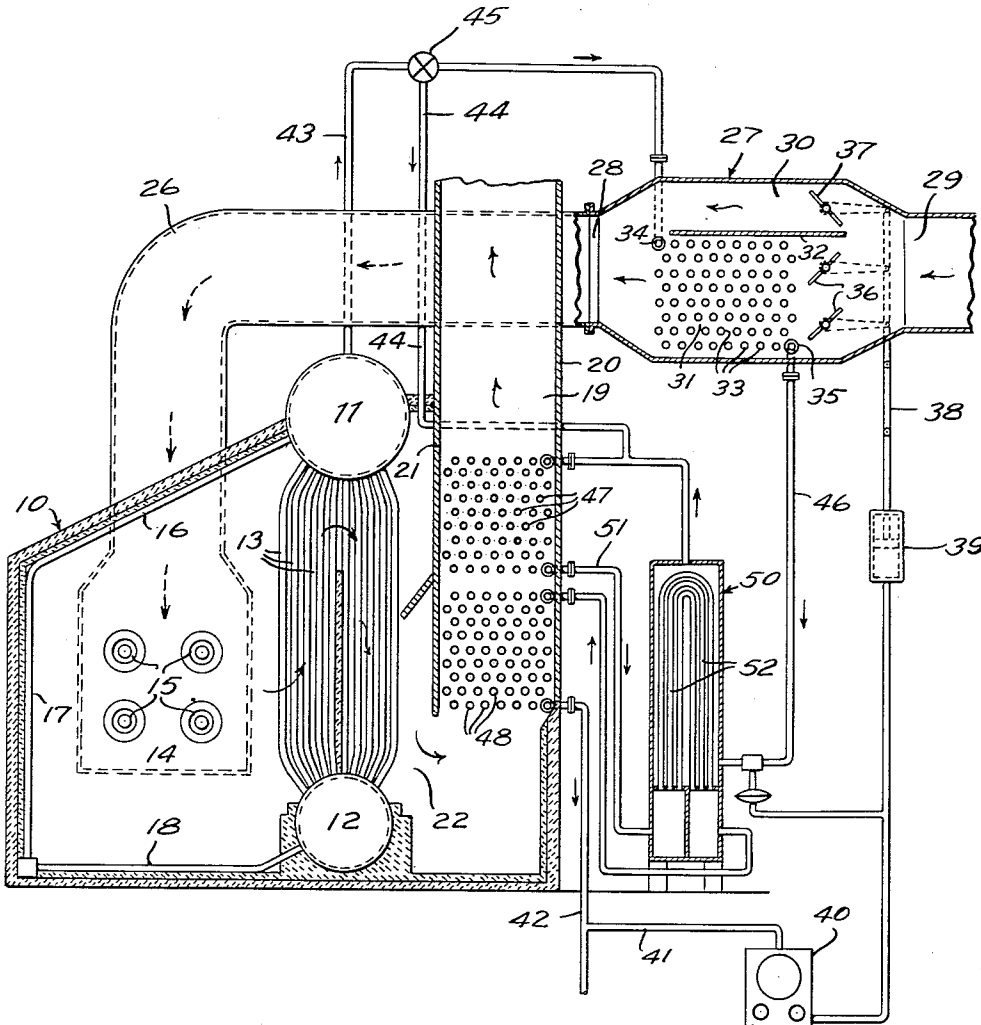
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VAPOR GENERATING AND SUPERHEATING APPARATUS

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4 Sheets-Sheet 4

Fig. 4.



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1

2,713,330

VAPOR GENERATING AND SUPERHEATING APPARATUS

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4 Claims. (Cl. 122—1)

This invention relates to vapor generators and more particularly vapor generators in which the saturated steam produced therein is superheated.

It is not unusual for such boilers to be provided with a superheater, a desuperheater and a resuperheater and for the extent of the desuperheating to be varied automatically in accordance with the final steam temperature. In this way, the final steam temperature can be closely controlled.

The invention is concerned with automatic control of the final steam temperature but does not necessarily involve desuperheating and resuperheating.

According to the invention, automatic means are provided which vary the flow of air through a steam condenser in accordance with variations in the final steam temperature and thus bring about condensation of a correspondingly variable proportion of the steam coming from the steam drum, the condensate being then mixed with the remainder of the steam from the steam drum either before the latter is superheated or while it is being superheated or between two stages of superheating.

The condensate can also, if desired, be additionally used for desuperheating in an indirect heat exchanger.

In a modified form of the invention, the whole of the steam from the steam drum is passed through the steam condenser which then serves to wet a variable proportion of the steam, that is to say, to produce a mixture which is the equivalent of that produced by mixing the condensate with the dry steam as was done in the form of the invention described above.

The invention will be understood from the following description when considered in connection with the accompanying drawings forming a part thereof, and in which:

Fig. 1 is a diagrammatic transverse section of the apparatus of one embodiment of the invention;

Fig. 2 is a view similar to Fig. 1 but of another embodiment of the invention;

Fig. 3 is a diagrammatic transverse section of the apparatus of a further embodiment of the invention; and

Fig. 4 is a view similar to Figs. 1, 2 and 3 but of a still further embodiment of the invention.

Like characters of reference refer to like parts throughout the several views.

Referring to the drawings, Fig. 1, the apparatus of the present invention is disclosed as embodying a vapor generator comprising a setting 10 having vapor generating surface therein with an upper steam and water drum 11 together with a lower water drum 12 which is disposed in the lower part of the setting in substantial vertical alignment with said upper drum. Drums 11 and 12 are connected by a substantially vertical bank of steam generating tubes 13.

At one side of the bank of tubes 13 is a furnace or combustion chamber 14 fired by a plurality of burners 15. The roof, side wall and floor of chamber 14 are lined by water tubes 16, 17 and 18 respectively.

On the side of the tube bank opposite to that on which

2

the chamber 14 is located is a substantially vertically extending gas passage 19 having an outer side wall 20 and an inner side wall 21. Passage 19 has a lower gas inlet 22 which receives gases from the furnace after they have passed over tube bank 13.

As shown in Fig. 1, a superheater 23 is disposed in gas passage 19, the superheater having a saturated vapor inlet 24 and a superheated steam outlet 25.

An air duct 26 through which air to support combustion in chamber 14 flows to burners 16 is provided. A steam condenser which comprises a casing 27 having an air outlet 28 and an air inlet 29 communicates with duct 26, the air outlet of the steam condenser being in communication with said duct. The casing 27 is divided into two parallel passages 30 and 31 by a baffle 32, passage 31 being the main passage and passage 30 being a by-pass. A tubular coil 33 having an inlet 34 and an outlet 35 is disposed in passage 31 so that air flowing from the inlet 29 to the outlet 28 of the steam condenser will pass over the coil. The passage of air through main passage 31 is controlled by dampers 36, while by-pass passage 30 is controlled by a damper 37. The dampers are moved between their opened and closed positions by a lever 38 which is operated by an actuator 39, the dampers 36 and 37 being so arranged in relationship to each other that when by-pass damper 37 is moved toward its open position, dampers 36 will be moved toward their closed position and vice versa. When the supply of air flowing through the by-pass 30 is increased, the supply of air flowing through main passage 31 will be decreased and when the supply of air flowing through main passage 31 is increased, the quantity of air flowing through by-pass 30 will be decreased.

Actuator 39 is operated by a damper controller 40 which is responsive through a thermostatic connection 41 to the outlet temperature of superheated steam flowing from superheater 23 through outlet conduit 42.

Saturated steam from upper steam drum 11 is conducted to inlet 34 of air condenser coil 33 through a saturated steam conduit 43, a portion of which steam is caused to flow through a by-pass conduit 44 which communicates with a proportioning valve 45 in conduit 43 intermediate the steam drum 11 and inlet 34 of coil 33. Outlet 35 of coil 33 is in communication with by-pass conduit 44 through line 46.

In operation, saturated steam from steam drum 11 flows through saturated steam conduit 43 to the inlet 34 of air condenser coil 33 thereafter to enter the coil. Proportioning valve 45 is so set that a portion of the steam flows into the superheater inlet through by-pass conduit 44. Dampers 36 and 37, in the normal operation of the apparatus of the present invention, are so set by actuator 39 that at a normal steam temperature in outlet conduit 42, temperature controller 40 is caused to operate said actuator so that the dampers are partially open and a portion of the air flows through by-pass passage 30 and another portion flows over coil 33 as it passes to the furnace. The steam flowing through coil 33 is thereby condensed and the condensate flows through line 46 into by-pass conduit 44. The mixture of condensate and saturated steam wets the steam as it passes into superheater 23.

During the operation of the present invention, the same proportion of the steam supply is normally passed through condensing coil 33 but the supply of air is controlled in accordance with the final steam temperature. Accordingly, an amount of steam will be condensed which at any time is proportional to the final steam temperature. Condensate, being mixed with the saturated steam from the steam drum, wets that steam to an extent dependent upon the final steam temperature. The latter temperature can thus be kept constant.

If superheated steam of a higher degree is desired, the

3

controller 40 is set for a higher temperature which causes the actuator to move dampers 36 toward a closed position and by-pass damper 37 to an open position so that less air flows over coil 33 and more air passes through by-pass 30, while if superheated steam of a lower temperature is desired, controller 40 is set for a lower temperature causing actuator 39 to move dampers 36 toward an open position and damper 37 toward a closed position so that more air will flow over coil 33 and less air will flow through by-pass 30.

The embodiment of the invention shown in Fig. 2 of the drawings, is similar to that shown in Fig. 1 but the superheater 23 is divided into two sections, an upper section 47 and a lower section 48 which are connected in series. The line 46 instead of conducting condensate to the superheater inlet introduces it into an intermediate point of the superheater wherein it is mixed with superheated steam issuing from section 47. According to the amount of condensate mixed with the superheated steam, the latter will either be desuperheated or simply tempered. In the former case, the second superheating stage can then be considered to be a resuperheater.

In the embodiment of the invention shown in Fig. 3, all of the saturated steam from drum 11 is passed into coil 33 in which event the proportioning valve 45 and by-pass conduit 44 of Fig. 1 is omitted.

The form of the invention shown in Fig. 4 is somewhat similar to that shown in Fig. 2 but the condensate is passed through a heat exchanger 50 and after heating in said heat exchanger is thereafter passed into by-pass conduit 44 wherein it wets the steam passing to upper superheater section 47. Superheated steam from upper section 47 flows through line 51 into heat exchanger 50 wherein it passes in indirect heat exchange relationship with the condensate which enters the heat exchanger through line 46. After flowing through tubes 52 of the heat exchanger, steam from superheater section 47 is passed into lower section 48.

It will be noted that in each of the embodiments of the invention, the heated air issuing from the steam condenser is used to support combustion in the furnace. Also, the amount of condensate or of wet steam which is fed to the superheater is controlled in accordance with the final steam temperature.

Inasmuch as changes may be made in the form, location and relative arrangement of the several parts of the apparatus disclosed without departing from the essential characteristics of the invention, it will be understood that the invention is not to be limited excepting by the scope of the appended claims.

What is claimed is:

1. In vapor generating apparatus comprising a vapor generator having a setting and a saturated vapor space, a furnace in the setting, said furnace having a gas outlet, means for firing the furnace, a steam condenser, means forming a main air passage and a by-pass passage in said condenser, tubular means forming a path of flow for saturated vapor and disposed in heat exchange relationship with air flowing through said main air passage only, said by-pass passage being arranged to conduct air flowing through the condenser out of heat exchange relationship with said tubular means, damper means for controlling the flow of air through said main air passage, other damper means for controlling the flow of air through said by-pass passage, actuating means for said damper means and said other damper means, control means for controlling actuation of said actuating means in response to the temperature of superheated steam, a superheater in heat exchange relationship with gases flowing to the furnace gas outlet, said superheater being in communication with the vapor space to receive vapor therefrom and comprising a plurality of sections connected in series, one section being disposed beyond another section in the direction of flow of said gases, said tubular flow path being in communication with the saturated vapor space to receive vapor there-

4

from, a conduit in communication with the tubular path of flow outlet and with said superheater between said one and the other sections thereof to conduct condensate thereto, and a saturated vapor proportioning valve in the path of flow of vapor from the vapor space to the superheater and to the tubular flow path to proportion the quantity of vapor flowing from said space to said superheater and to said flow path.

2. In vapor generating apparatus comprising a vapor generator having a setting and a saturated vapor space, a furnace in the setting, said furnace having a gas outlet, means for firing the furnace, a steam condenser, means forming a main air passage and a by-pass passage in said condenser, tubular means forming a path of flow for saturated vapor and disposed in heat exchange relationship with air flowing through said main air passage only, said by-pass passage being arranged to conduct air flowing through the condenser out of heat exchange relationship with said tubular means, damper means for controlling the flow of air through said main air passage, other damper means for controlling the flow of air through said by-pass passage, actuating means for said damper means and said other damper means, control means for controlling actuation of said actuating means in response to the temperature of superheated steam, a superheater in heat exchange relationship with gases flowing to the furnace gas outlet, said superheater being in communication with the vapor space to receive vapor therefrom and comprising a plurality of sections, one section being disposed beyond another section in the direction of flow of said gases, said tubular flow path being in communication with the saturated vapor space to receive vapor therefrom and with said superheater to discharge condensate thereto, a heat exchanger comprising two fluid flow paths so constructed and arranged that the fluid in one flow path passes in indirect heat exchange relationship with the fluid in the other flow path, saturated vapor conduit means in communication with the vapor generating space to receive saturated vapor therefrom and with the inlet of said one superheater section to conduct saturated vapor thereto, saturated vapor proportioning valve means in the path of flow of vapor from the vapor generating space to the tubular flow path to proportion the vapor flowing to each thereof from the vapor generating space, a condensate conduit in communication with the tubular path of flow outlet and the inlet of one of the heat exchanger flow paths, another condensate conduit in communication with the outlet of said one of the heat exchanger flow paths and with the inlet of said one superheater section, a superheated vapor conduit communicating with the outlet of said one superheater section and with the inlet of the other heat exchanger flow path, and a desuperheated vapor conduit communicating with the outlet of said other heat exchange path of flow and the inlet of the other superheater section.

3. In vapor generating apparatus comprising a vapor generator having a setting and a saturated vapor space, a furnace in the setting, said furnace having a gas outlet, means for firing the furnace, a duct supplying combustion air to said furnace, means forming a main air passage and a by-pass passage in said air duct, a steam condenser comprising tubular means forming a path of flow for saturated vapor and being in communication with the saturated vapor space to receive vapor therefrom, said tubular means being disposed in said main air passage and in heat exchange relationship with the combustion air flowing through said main air passage only, said by-pass passage being arranged to conduct combustion air flowing through said duct out of heat exchange relationship with said tubular means, damper means in said main passage controlling the flow of combustion air therethrough, second damper means in said by-pass passage controlling flow of air therethrough, said first mentioned damper means being operable in

5

one direction to increase the flow of air through said main air passage and in another direction, opposite to said one direction, to decrease the flow of air there-through while said second damper means is operable in said one direction to decrease the flow of air through said by-pass passage and in said other direction to in-crease the flow of air therethrough, movable actuating means drivably connected to both said damper means for simultaneously positioning the latter in opposite di-rections, said actuating means in one position operating said damper means to provide flow of combustion air through said main air passage only and in a second posi-tion operating said damper means to provide flow of combustion air through said by-pass passage only, a superheater in heat exchange relationship with gases 15 flowing to the furnace gas outlet, said superheater being in communication with the saturated vapor space to re-ceive vapor therefrom, the tubular flow path also be-ing in communication with the saturated vapor space to receive vapor therefrom and with said superheater to discharge condensate thereinto, means responsive to the temperature of the superheated steam for controlling the position of said damper means, and a saturated vapor proportioning valve in the path of flow of vapor from the vapor space to the superheater and to the tubu-

6

lar flow path to proportion the quantity of vapor flow-ing through said space to said superheater and to said flow path.

4. The apparatus of claim 3 wherein the superheater inlet and the vapor space are in communication with one another through a saturated vapor conduit and the tubular flow path outlet is in communication with said saturated vapor conduit so as to conduct condensate thereinto and wherein the proportioning valve is so posi-tioned as to proportion flow of vapor from the vapor space to said saturated vapor conduit and to said tubular flow path.

References Cited in the file of this patent

UNITED STATES PATENTS

249,502	Carvalho	Nov. 15, 1881
1,439,862	Broido	Dec. 26, 1922
2,133,991	Kerr	Oct. 25, 1938
2,319,223	Frisch	May 18, 1943
2,320,911	Cooper	June 1, 1943
2,623,507	Brinig	Dec. 30, 1952

FOREIGN PATENTS

612,230	Germany	Apr. 16, 1935
575,509	Great Britain	Feb. 21, 1946